**Proximal Humerus Fractures - What to do in young active patients?**

Phani K. Dantuluri, MD  
Shoulder and Elbow & Upper Extremity Surgery  
Resurgens Orthopaedics  
Emory University Midtown Hospital  
Emory St. Joseph’s Hospital

---

**Proximal Humerus Fractures**

- Five percent of all fractures
- 80% minimally displaced stable fractures
- Only 20% need surgical treatment
- Often associated with poor functional outcome
- Less poor outcomes with nonop than operative treatment

---

**Proximal Humerus Fractures**

- Age
- Bone Quality
- Demands of patient
- Head Viability (Hertel)
- Tuberosities most important
- No consensus on which fractures should be operated on
Vascular Anatomy

Ascending anterolateral branch of the anterior circumflex artery

Greater Tuberosity Fracture

Orthogonal Views

Greater Tuberosity Fracture

More displaced Greater Tuberosity Fracture

THE Greater Tuberosity

• May underestimate greater tuberosity displacement on AP view
• Y view and axillary view necessary to fully appreciate displacement
• Less displacement tolerated with greater tuberosity fractures

Displaced Greater Tuberosity Fracture
What fracture displacement can we accept???

- Only few criteria to determine correlation between displacement and function
  - Head/Tuberosity relationship
    - Seem to be critical for function
    - Malunion difficult to manage
  - Surgical neck
    - Forward elevation decreases in direct proportion to fracture angulation
    - Varus deformity leads to subacromial impingement
    - Malunion easier to manage

Indications for treatment

- Displaced unstable fracture
- Multiple trauma
- Associated UE fracture
- Vascular injury
- Compliant patient

What do we need to do?

- Reestablish the tuberosities in the proper position. GT and LT in relation to the head
- GT has three of four RC muscles attached to it
- Preserve the blood supply
Internal Rotation View

Difficult technique
Tedious technique
Requires Team approach
Requires learning curve

CRPP

• 2-Part Surg Neck Fx displaced/angulated
• Young patient with good bone
• Compliant patient

CRPP Ideal Indications
CRPP Contraindications

- Non-compliant patient
- Severe comminution
- Marked osteopenia
- (4-part fractures)
- Fracture dislocations
- Some 3-part fractures

CRPP Technique

- Proper patient positioning is essential. Use regular table not beach chair
- Preoperative trial reduction
- Plan maneuver and position c-arm properly
- Have all Pins (2.5 mm terminal thread pins)
- Have all screws (4.0 AO cannulated)
CRPP Technique

- Longitudinal Traction
- Mechanical arm holder helpful
- Posterior pressure on humerus corrects apex-anterior angulation or anterior shaft displacement

CRPP Technique

- Do reduction first
- Hold pin over shoulder
- Image in A-P plane
- Small incision
- Spread to bone
- Insert first pin (a)
- Insert second pin (a)
- Axillary view to check
- Insert third pin (b)
- Insert fourth/fifth pins (c) as needed for greater tuberosity

CRPP Technique

- Trim pins under skin
- Shoulder immobilizer
- Pendulums O.K. if no proximal pin(s)
- No passive ROM for 3-4 weeks
- Serial x-rays q week for 4 weeks
- Remove any proximal pin(s) at 3 weeks
- Remove other pins at 4-6 weeks
Locking Plates

LOCKING SCREWS
MULTIPLE ANGLES

ORIF Locking Plates

- Beach chair position
- Separate padded Mayo Stand
- Deltopectoral approach or Lateral Approach
- Maintain vascularity of fragments
- Control Tuberosities, Use Sutures to reduce
- Reduce head portion of fracture and fix with K-wires
- May be preferable to reduce head to shaft prior to plate application
- Avoid placement of K-wires that will interfere with plate application
Positioning

- Beach Chair Positioning
- Prep entire shoulder girdle
- Intraoperative Fluoro available
- Padded Mayo Stand

Surgical Approach

- Locate Biceps tendon as guide
- Minimize stripping
- Get control of the tuberosities with suture
- Traction is key

Surgical Technique
Contralateral Template

Provisional Reduction

Plate Positioning

- Must be below rotator cuff insertion
- Avoid impingement
- Distal enough so that calcar support screws perfect
- Orthogonal views critical for good screw spread
Must check plate position on multiple views to verify correct placement!

Metaphyseal Bone Loss

Valgus Impacted Pattern
Postoperative Protocol

- Go SLOWER to avoid tuberosity displacement
- Easier to deal with a stiff healed ORIF, than one with tuberosity failure
- Gentle PROM, then AAROM at 6 weeks, Strengthening at 12-16 weeks
- Monitored Hydrotherapy if possible

Intramedullary Fixation

- Multiplanar Head Fixation
- Cannulated for Guidewire Insertion
- Minimally Invasive

Intramedullary Rods
Intramedullary Rods

Can we do better?

YES!

Next Generation Nails

Pascal Boileau, MD

Problems with Locked Plates

TOTAL: 49%
Varus MU 16%
AVN 10%
Screw perfs 14%
Nonunion 3%

517 Cases

Sproul et al, Injury 2011
Why Complications?

Add more metal?  Fibular strut?

Why IM Fixation?

- Shares compressive, bending, and torsional loads with the bone
- Internal splint
- Internal scaffold
Robust Healing

Issues with Distal Fixation

Locked Plate Hardware Failure
Metaphyseal Commination

Greater Tuberosity Violation

Need Locking Screws
Solution: Nylon/PE Bushing
Reduction Tricks

Multicenter Study

• Articular Entry

2PT Surgical Neck Fx Study

☐ All fractures healed
☐ 37/38 (97%) healed with neck-shaft angle of at least 125 degrees
Results of Study

- Average Constant Score 71 (97%)
- Average pain score 13 (15 = no pain)
- Average FF 132 degrees

Results of Plating Surgical Neck Fxs

- Olerud et al, JSES 2010
  - 44 patients
  - 10% patients with “Bad” reductions (NSA < 115 degrees)
  - 46% lost reduction (ave 22 degrees)

Results of Plating Surgical Neck Fxs

- Olerud et al, JSES 2010
  - 26 pts with initial undisplaced GT Fx’s
  - 19% displaced after ORIF
  - Screw penetration through HH 14%
  - Secondary displacement requiring reoperation 7%
  - 2 nonunions 5%
  - 3 hemiarthroplasties 7%
Why so many complications?

Fracture Deforming Forces

Cannot Neutralize with Plating
Need Screws Perpendicular to the Fracture lines

Screws Point Away from Joint

Unhappy Triad

1. GT migration
2. Humeral Head Necrosis
3. Glenoid Erosion

Pascal Boileau, MD
Importance of Tuberosity Fixation
Headless Fixation

Why IM nail?

IM Nail Surgical Technique
Preop AP
- Inferior displacement of humeral head
- Greater tuberosity "locked" above humeral head
Lesser and Greater tuberosity fractured, but held together by cuff

Shaft comminution

Preop Axillary View

Calcar reduces, indicating intact medial periosteal hinge

Intraoperative Traction View

Reduction Tricks
**Preliminary Reduction**

Near Anatomic Reduction

---

**Preliminary Reduction**

Greater Tuberosity Humeral Head Reduction Held with 2.5mm terminally threaded Steinmann Pin

---

**IM Nailing**

Placing Guide Pin (For Nail) Insertion

---
Nail Insertion Over Guide Pin

Outlet View

First Greater Tuberosity Screw

- Nail rotated into slight retroversion to capture largest greater tuberosity fragment, under direct visualization.
Greater Tuberosity Fixation
First Greater Tuberosity Screw Placed Fixes tuberosity and supports anteromedial humeral head

Greater Tuberosity Fixation
Outlet view

Greater Tuberosity Fixation
Second Greater Tuberosity Screw
Greater Tuberosity Fixation

Outlet View

Distal Screw Fixation

Placing Distal Screw Dynamic Slot

Completed IM Nailing

Final Construct
Final Fluoroscopic Image

Postoperative Radiographs
Note near anatomic lesser tuberosity placement secondary to intact cuff and fixation of greater tuberosity

Preoperative Radiographs
One Week Postop Radiographs

Greater tuberosity
Lesser tuberosity
Shaft comminution

One Week Postop Radiographs

Note early controlled impaction at distal screw, humeral head and greater tuberosity fracture sites

Final Outcome
Case 2

Head Splitting Fractures

Head Splitting Fractures